Unpacked South Dakota State Mathematics Standards

Purpose: In order for students to have the best chance of success, standards, assessment, curriculum resources, and instruction must be aligned in focus, coherence, and rigor. Unpacked standards documents are intended to help align instruction to the focus, coherence, and rigor of the South Dakota State Mathematics Standards. The standards have been organized in clusters as they are not so much built from topics, but rather woven out of progressions. Not all content in a given grade is emphasized equally in the mathematics standards. Some clusters require greater emphasis than others based on the depth of the ideas, the time that they take to master, and/or their importance to future mathematics or the demands of college and career readiness. To say that some things have greater emphasis is not to say that anything in the standards can safely be neglected in instruction. Neglecting standards will leave gaps in student skill and understanding and may leave students unprepared for the challenges of a later grade.

Domain: Precalculus	Grade Level: 4th Year

HS4.PC.L.B Cluster: Define limits. Students will develop an understanding of limit and how to both estimate and calculate them.
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This is a SUPPORTING cluster. *Students should spend the large majority of their time (65-85%) on the major work of the grade. Supporting work and, where appropriate, additional work should be connected to and engage students in the major work of the grade.*

PC.L.2 Demonstrate knowledge of both the definition and graphical interpretation of limits of values of functions and sequences. Verify and estimate limits using graphs, tables, and technology.
PC.L.3 Evaluate limits of functions and apply properties of limits, including one-sided limits and limits at infinity using algebra.

Aspects of Rigor of Student Learning: (Conceptual, Procedural, and/or Application)

PC.L.2 Demonstrate knowledge of both the definition and graphical interpretation of limits of values of functions and sequences. Verify and estimate limits using graphs, tables, and technology.

Conceptual Understanding	Procedural Fluency	Application
Students should develop an informal understanding of the definition of limit. The formal definition of limit will be studied in a college level Calculus course. Students should understand that a limit is the y-value that the function is approaching for a given x-value. It is possible that the limit does not exist. When a limit does not exist, we often see an asymptote, a step, or an oscillation.	Students will use table, graphs, and technology to estimate limits.	

PC.L.3 Evaluate limits of functions and apply properties of limits, including one-sided limits and limits at infinity using algebra.

Conceptual Understanding	Procedural Fluency	Application
Students understand the properties and manipulations needed to find a limit. Students understand that a graph or table can be used to **approximate** the	Students should evaluate limits algebraically.	

limit, but must use algebraic manipulations to evaluate the limit.		

Enacting the Mathematical Practices - Evidence of Students Engaging in the Practices

1. **Make sense of problems and persevere in solving them.**
2. **Reason abstractly and quantitatively.**
3. **Construct viable arguments and critique the reasoning of others.**
   - Students should be able to justify the value of the limit.
4. **Model with mathematics.**
5. **Use appropriate tools strategically.**
6. **Attend to precision.**
   - Students must be aware of the difference between estimating a limit using a graph or table as opposed to evaluating the limit explicitly using algebraic manipulations.
7. **Look for and make use of structure.**
8. **Look for and express regularity in repeated reasoning.**

Vertical and Horizontal Coherence and Learning Progressions

Previous Learning Connections	*Current Learning Connections*	*Future Learning Connections*
In Algebra II students graph rational functions and encounter vertical asymptotes, horizontal asymptotes, and holes which lead to the discussion of discontinuity.	Students will use limits to formally define both vertical and horizontal asymptotes. Students will develop an understanding of limit and how to both estimate and calculate them.	The concept of limits is critical for all of calculus. Students will use limits to define continuity, derivatives, and integrals.

Vocabulary (key terms and definitions)

- Limit
- Asymptotes
- Step discontinuity
- Oscillation
- Infinite limit

Relevance, Explanations, and Examples: